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13. ABSTRACT *(Maximum 200 words)*

The presentation will provide system design including a description of the commands, outputs and diagnostic capabilities provided by the ADS we created. Issues and Decisions will also be described as will thoughts on potential new features that could be added to the system. The presentation will also provide thoughts and remarks on Extensibility to other types of A/C as well as a few Lessons Learned.

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27

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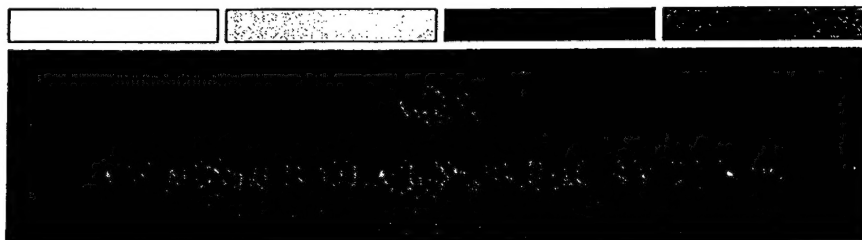
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AVIONICS DIAGNOSTIC SYSTEM JAWS'99 1

DETAILS OF SYSTEM DESIGN AND DIAGNOSTIC
CAPABILITIES

ISSUES AND LESSONS LEARNED

THREE ILLUSTRATIVE SESSIONS
- **SESSION 1** - LAB TEST AND DEVELOPMENT BENCH
- **SESSION 2** - A/C CHECKOUT ON GROUND
- **SESSION 3** - ANALYSIS OR TROUBLESHOOTING
  OF DATA RECORDED DURING FLIGHT

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   2

SCOPE OF PRESENTATION:

The presentation will provide system design including a description of the
commands, outputs and diagnostic capabilities provided by the ADS we
created. **Issues and Decisions** will also be described as will thoughts on
potential new features that could be added to the system. The presentation will
also provide thoughts and remarks on **Extensibility** to other types of A/C, as
well as a few **Lessons Learned**.

BUT FIRST:

To orient us with the operation of the system lets start with three <u>example
scenarios</u> each of which shows us some of the diagnostic capabilities of the
ADS.

The first session will illustrate how an operator uses the Diagnostics display
to determine which avionics RT's are having problems and what is wrong with
them, and to locate and read those portions of the electronified technical
manuals that are related to actions necessary to correct such problems.

The second session show ways the ADS assists an operator in identifying and
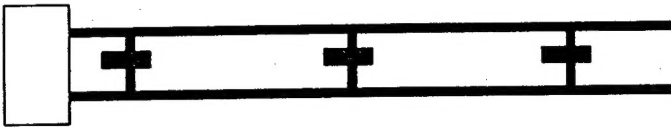locating problems with 1553 bus connectors.

The third session shows how the ADS may be used to analyze and examine
data collected during a flight.

EXIT | **HISTORY** | **USER MANUAL** | **BIT SUMM** | **1553**

Aircraft Type: F14   DCF: D:\0201-F1.DAT Analyzed 11253 msgs
(in range 0..500000) (Normal Termination)

1 Avionics Errors Detected, 0 Bus Connectivity Errors

Diagnostics Program Warnings Exist (click here to enter Errors File)

F14, MISSION COMPUTER 1 IS BC

Click Here for Recommended Actions

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   3

Session / Scenario 1

Assume that the ADS was started with startup conditions that specified
AutoCollect=True, AutoDiagnose=True and some CollectionTime.

The ADS on startup (on turning the machine on) will collect bus data for the
specified period then upon successful collection of bus data put up the
Avionics Diagram Page.

In this case we are illustrating that the collection and analysis has found no bus
messages for the Doppler RT, so the DOP is colored Red. The ADS user when
presented the ADP will first check the number of messages analyzed and the
number of errors determined. Since errors exists and since the DOP RT is Red
the user clicks on the DOP with the LMouse to see why it is colored Red.
After reading the list of DOP faults diagnosed, which will have one fault
"DEAD_DOPPLER", the user then clicks on the DOP with the RMouse
causing the Technical Publications to be displayed for the Doppler so the user
can determine where the Power Switch, Breakers and Cabling are located on
the device.

| EXIT | HISTORY | USER MANUAL | BIT SUMM | 1553 |

Aircraft Type: F14   DCF: D:\0201-F1.DAT Analyzed 11253 msgs
(in range 0..500000) (Normal Termination)

0 Avionics Errors Detected, 1 Bus Connectivity Errors

Diagnostics Program Warnings Exist (click here to enter Errors File)

F14, MISSION COMPUTER 1 IS BC

Click Here for Recommended Actions

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   4

Session / Scenario 2

Assume that the ADS was started with startup conditions that specified
AutoCollect=True, AutoDiagnose=True and some CollectionTime.

The ADS on startup (on turning the machine on) will collect bus data for the
specified period then upon successful collection of bus data put up the
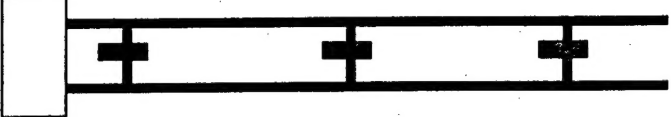Avionics Diagram Page.

In this case we are illustrating that the collection and analysis has found no bus
messages for the portion of the bus that is served by a specific connector and
as a result the Bus Connectivity algorithm has asserted an possible open-
circuited connector at that bus connector. The ADS user when presented the
Avionics Diagrram Page will first check the number of messages analyzed and
the number of errors determined. Since a Bus Connectivity error exists the
user first uses the Lmouse on one of the Red bus graphical symbols to cause
the ADS to put up the list of Bus Connection Errors. These specify the
identification of the connector(s) suspected of being open-circuited. After
identifying the connector the user then uses the RMouse (cursor over the Red
bus graphical symbol) to cause the Technical Publications to be displayed.
When the Tech Pubs are opened in this manner they will position the
document at the page which shows where the connector of interest is located in
the aircraft and also which of the 5 connectors is the connector of interest.

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┌──────────────────────────────────────────────────────────────┐
│                                          ⋆⋆    RESEARCH &      │
│                                         ⋆⋆⋆⋆⋆   ENGINEERING    │
│                                                               │
│  ┌──────────────────────────────────────────────────────┐    │
│  │ EXIT │ HISTORY │ USER MANUAL │                         │    │
│  │                                                        │    │
│  │  Session Error/Warnings File:                          │    │
│  │  ┌──────────────────────────────────┐ ┌───┐           │    │
│  │  │                                  │ │ ▲ │           │    │
│  │  │                                  │ │ ▼ │           │    │
│  │  └──────────────────────────────────┘ └───┘           │    │
│  │     ┌──────────────┐                                   │    │
│  │     │  Unknown     │  COLLECT BUS DATA                 │    │
│  │     │  Unknown     │  RUN DIAGNOSTICS                  │    │
│  │     │  Unknown     │  RUN PARAMETERS MOD               │    │
│  │     └──────────────┘  RUN PUBLICATIONS VIEWER          │    │
│  │                                                        │    │
│  │  Current A/C Type: F14          DATA:                  │    │
│  │  ┌──────────────────────────────────┐ ┌───┐           │    │
│  │  │                                  │ │ ▲ │           │    │
│  │  │                                  │ │ ▼ │           │    │
│  │  │ D:\0201-F2.DCF  D:\0101-F1.DCF  C:\0130-F1.DCF │    │    │
│  │  └──────────────────────────────────┘                 │    │
│  │                                                        │    │
│  │  ┌──────────────────────────────────────────────┐     │    │
│  │  │ Executive Messages:                           │     │    │
│  │  │   => No Messages                              │     │    │
│  │  └──────────────────────────────────────────────┘     │    │
│  │                                                        │    │
│  └──────────────────────────────────────────────────────┘    │
│     AVIONICS DIAGNOSTIC SYSTEM          JAWS'99    5           │
└──────────────────────────────────────────────────────────────┘
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Session / Scenario 3   [Part 1]

Assume that the ADS was started with startup conditions that specified
AutoCollect=False, AutoDiagnose=False and some CollectionTime.   Under
these conditions the ADS on startup (on turning the machine on) will display
the Executive Program's Display Page and await user commands.

Assume for this scenario the user has been given data collection file(s) that
were collected during a flight. After identifying the file to be examined the
user effects a Parameters Modification to

specifying the data collection file of interest

tailor the analysis session as for example can be done by

selecting the portion of the data collection file to be analyzed,

whether disassembly of messages is to occur,
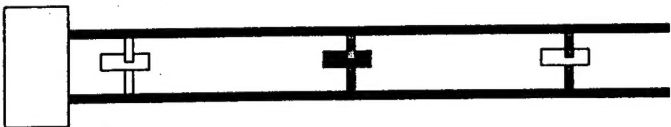
and other similar commands.

In this case since the user knows that one of the RT's was powered down
during the flight the user indicates that RT is Offline. After exiting Parameters
Modification upon return to the Executive's Display Page the user clicks on
Run Diagnostics to cause the ADS to analyze the bus messages in the selected
portion of the file. After Diagnostics finishes processing it presents the user
with the results of analysis, as the Avionics Diagnostics Page.

EXIT | HISTORY | USER MANUAL | BIT SUMM | 1553

Aircraft Type: F14 DCF: D:\0101-F1.DAT Analyzed 11253 msgs
(in range 0..500000) (Normal Termination)

1 Avionics Errors Detected, 0 Bus Connectivity Errors

Diagnostics Program Warnings Exist (click here to enter Errors File)

F14, MISSION COMPUTER 1 IS BC

Click Here for Recommended Actions

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   6

Session / Scenario 3   [Part II]

The Avionics Diagram Page (ADP) presents information determined during analysis as colorable graphics and by making text reports available

The ADS user when presented this ADP will first check the number of messages analyzed and the number of errors determined. In this case there were no Bus Connectivity errors determined but an avionics error was determined by the ADS.

The user can determine what errors were asserted by either clicking with the LMouse on White Space (produces list of all errors) or clicking with the LMouse on the Red RT (produces list of errors asserted for that individual RT). This display illustrates the output as will occur where there was an unacceptable level of 1553 communications errors that occurred on an RT's secondary bus.

In this display the RT designed Offline is colored White. Another RT is colored Yellow to indicate the ADS was not able to fully determine its health, perhaps because there were not sufficient BIT messasges for the RT within the portion of the file that was analyzed.

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1. Goal = Diagnose Health of Avionics RT's (such as VOR, TACAN, AHRS, MISSION COMPUTER(s), and DOP) as determinable by <u>1553 bus monitoring</u>.

2. In addition the ADS shall include

- assessment of **integrity of bus cabling** (are bus connectors open-circuited). In addition be able to tell if the bus cabling is working/connected.

- provision of and indexing of diagnosed faults to **electronified Technical Publications.**

3. The scope of its operational capability is to provide assistance to an operator in performing **O-Level maintenance**. The ADS was not to provide intra-box diagnostics but was to provide assistance to the operator for making the determination of whether there is a need to examine a box or cabling or to swap out a box.

4. The application shall use **GUI**'s and **colorable computer graphical displays** to provide rapid and portable assessment of the results of diagnoses. The system will fully remove need to interpret bus messages at the bit level.

5. The system was to provide **Recommended Actions** to the operator. These messages describe how to use the ADS system and also the actions that are necessary in order to check-out bus and avionics equipment.

OBJECTIVES, ctd

INITIAL HOSTING FOR TWO TYPES OF AIRCRAFT

CREATE THE SYSTEM SO THAT EXTENSIBILITY TO OTHER TYPES OF AIRCRAFT IS FACILITATED

GUI-BASED WINDOWS APPLICATION

OPERATION SHOULD BE INTUITIVELY OBVIOUS
- output interpretable without functions to provide Help text

LEVERAGE EXISTING DATA COLLECTION PROGRAM AND EXPERTISE

OPERATE ON A PORTABLE PC (ruggedized, CD-ROM)

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   8

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1. Leverage. Make use of an (existing) Data Collection Program that uses a 1553 card to collect and display (all) 1553 bus message traffic. Leverage its source code, program functionality, and the expertise of lab personnel familiar with it.

2. This phase developed and tested on a PC-tower, migration to a LapTop was anticipated.

3. Training - this work provided our initial learning and exerience on how to make Windows Apps with Microsoft Visual C++.

8
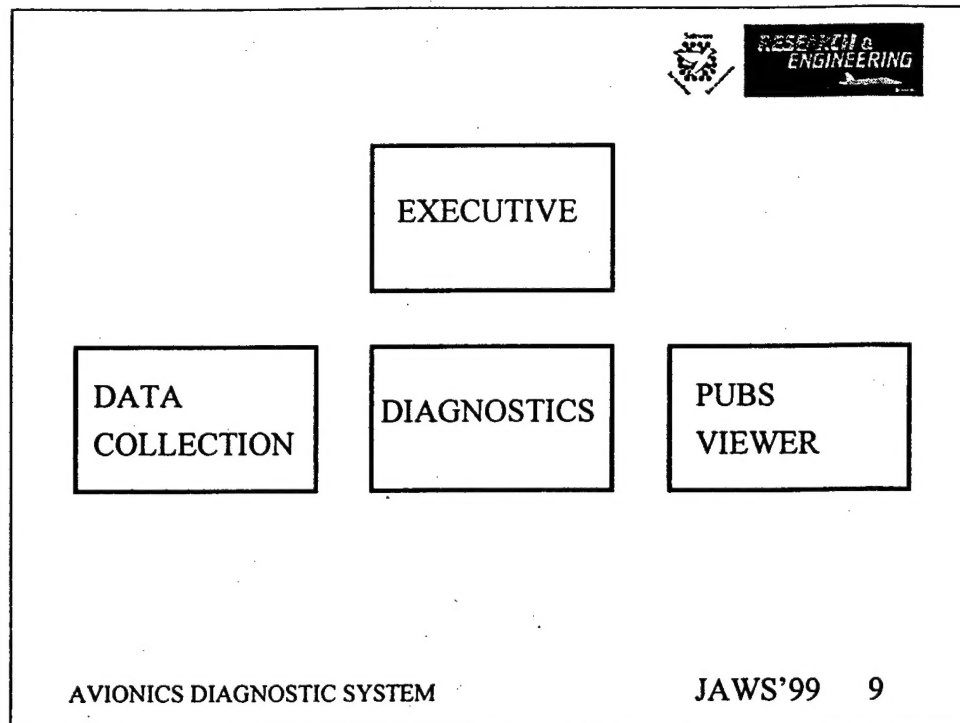
ADS is comprised of 4 modules

EXECUTIVE   DATA COLLECTION

DIAGNOSTICS   PUBLICATIONS VIEWER

EXECUTIVE - Error display, user interface for session control and access to pubs for browsing. Entry to the Exec is optional, it may never be entered.

DATA COLLECTION - we modified an existing program slightly, it provided us with a 1553 card interface that collects 1553 bus traffic and adds the formatted bus data to a Collection File. This tool also had and providesd us with diassembly and message viewing capabilities. We modified it to add the means to control the length of bus data collection, a means for reporting the status of the collection attempt, and an way to control its operation so it provides either just collection or collection with subsequent return to its main menu.

DIAGNOSTICS - data analysis (RT health messages, 1553 comms and connectivity), graphical display of avionics and bus health, ability to transition to specific parts of Pubs, summaries such as number of BIT messages, 1553 errors, if Mission Computer switched, number of times RT switched primary bus, presence of and number of hard and soft BIT errors.

PUBLICATIONS VIEWER - we slightly modified a program being developed for separate task, for ADS provides access to electronified a/c and ads related publications (technical maintenance manuals, users manual).

Modes of Operation were defined, AutoColl and/or AutoDiag or just put up Executive.
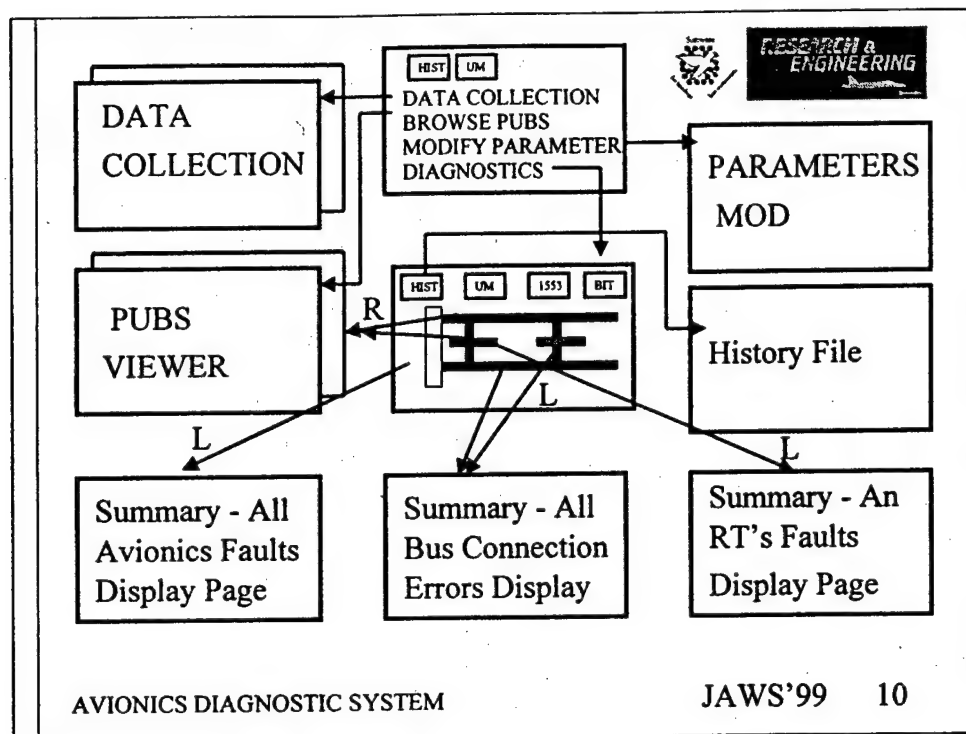
This viewgraph shows how the Mouse and Menu items allow the operator to view ADS outputs and to interface with the on-line technical publications.
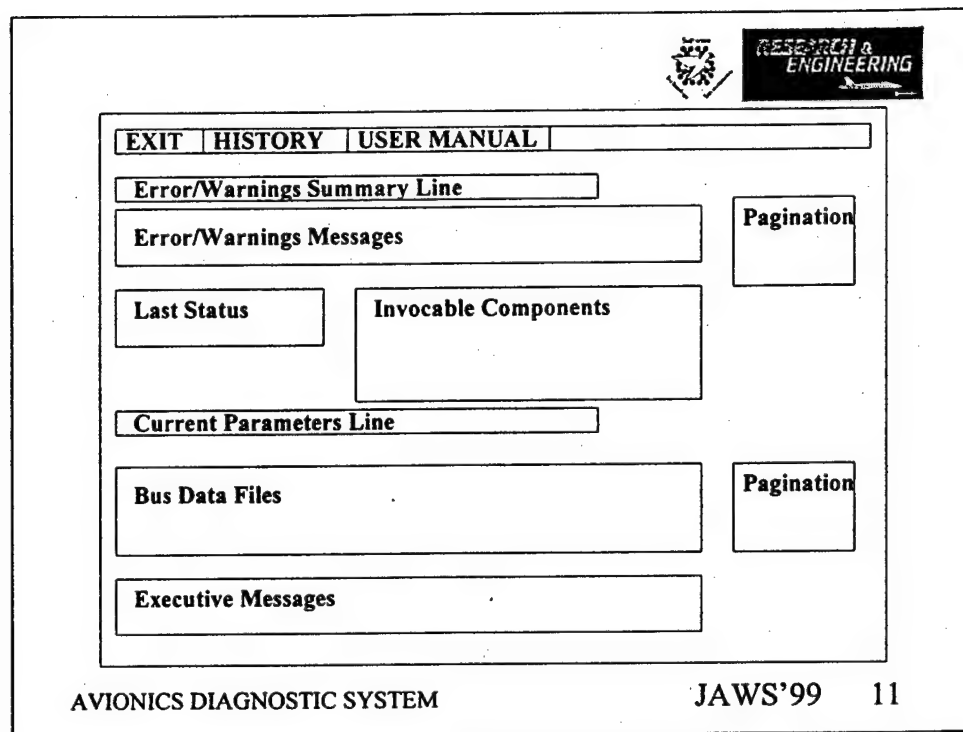
Display Areas Defined for the Executive Program's Display Page

This viewgraph shows the organization of (control and of writable display) areas of the Executive Programs Display Page.

This display provides both an overview summary of the Session so far, and the ability to scroll through the System Status File that has resulted from a Diagnostic Session, and the means to set up for a subsequent Diagnostics run.

The Last Status area provides the status of three of the invocable programs. These status are provided both as as text and as a color code.

The Bus Data files lists the collection files presently on the computer, these files may be used as input to the ADS to drive an ADS session. When the ADS collects bus data a new file is created, its name will appear here.

EXIT | HISTORY | USER MANUAL |

Session Error/Warnings File: 1 Error Message

[1] PCA 1.0 NORMAL TERMINATION

Unknown	**COLLECT BUS DATA**
Unknown	**RUN DIAGNOSTICS**
	RUN PARAMETERS MOD
	RUN PUBLICATIONS VIEWER

Current A/C Type: F14   DATA: D:\0201-F1.DCF

D:\0201-F2.DCF   D:\0101-F1.DCF   C:\0130-F1.DCF

Executive Messages:
=> Recollect Bus Data

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   12
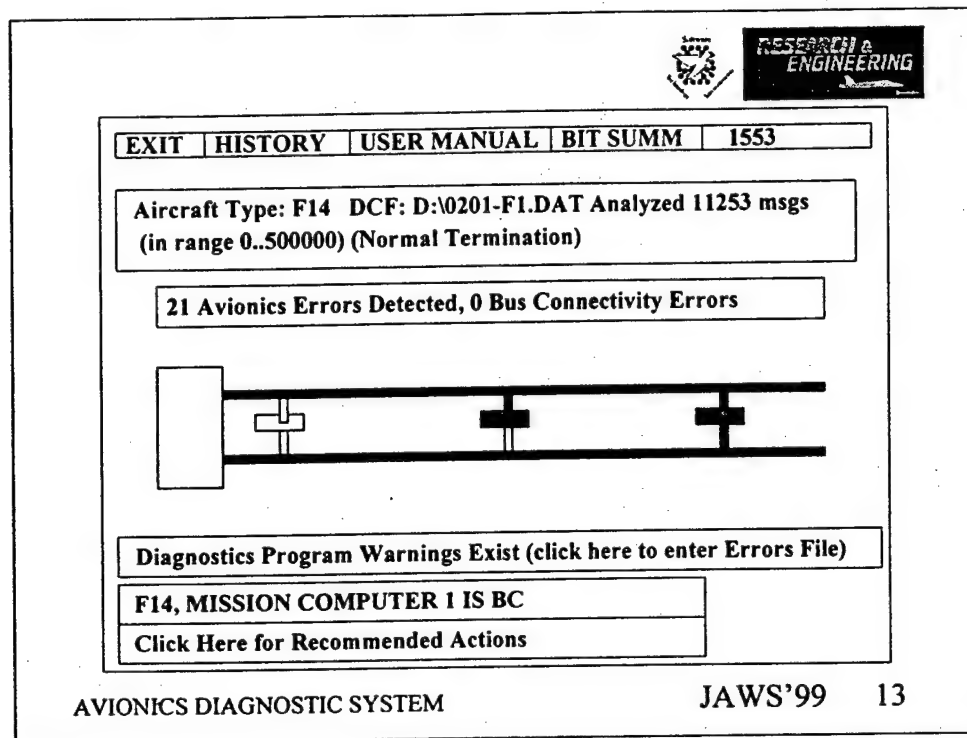
Illustrative Executive Program Display Page

This shows an example Executive Program display in which each of the Executive's Display Areas are populated with data related to the state of the ADS session.

(OPTIONAL) MEANING OF COLORS - probably discussed only if ? asked

    Collect Bus Data. <u>Unknown</u> (turquoise) - has not been run during this session; <u>Fatal</u> (red) - missing collection results file or fatal err; <u>Warnings</u> (yellow) - collection was run but unwelcome updates resulted; <u>OK</u> (green) - collection run intrasession, collection results file present, no unwelcome updates

    Run Diagnostics. <u>Unknown</u>(turquoise) - missing Diag Results File; <u>Fatal</u>(red) - error in Diag Programs display phase;<u>Warnings</u>(yellow) - sum Fatal Err Flags and NumPCAWarns > 0; <u>OK</u>(green) -prev sum is 0

    Run Parameters Mod. <u>Unknown</u>(turquoise)-file error; <u>Fatal</u>(red)- fatal error during CP pgm op; <u>Warnings</u>(yellow) - result file indicates Warnings; <u>OK</u>(green) - no problems indicated in results file.

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┌─────────────────────────────────────────────────────────────────┐
│                                              ╔═══════════════╗    │
│                                       ✈       ║ RESEARCH &    ║    │
│                                              ║ ENGINEERING   ║    │
│                                              ╚═══════════════╝    │
│  ┌──────────────────────────────────────────────────────────┐   │
│  │ EXIT │ HISTORY │ USER MANUAL │ BIT SUMM │   1553           │   │
│  └──────────────────────────────────────────────────────────┘   │
│  ┌──────────────────────────────────────────────────────────┐   │
│  │ Aircraft Type: F14  DCF: D:\0201-F1.DAT Analyzed 11253 msgs│  │
│  │ (in range 0..500000) (Normal Termination)                 │   │
│  └──────────────────────────────────────────────────────────┘   │
│   ┌────────────────────────────────────────────────────────┐    │
│   │ 21 Avionics Errors Detected, 0 Bus Connectivity Errors  │    │
│   └────────────────────────────────────────────────────────┘    │
│                                                                  │
│   ┌────────────────────────────────────────────────────────┐    │
│   │ Diagnostics Program Warnings Exist (click here to enter  │   │
│   │ Errors File)                                             │    │
│   └────────────────────────────────────────────────────────┘    │
│   ┌────────────────────────────────────────────────┐            │
│   │ F14, MISSION COMPUTER 1 IS BC                  │            │
│   ├────────────────────────────────────────────────┤            │
│   │ Click Here for Recommended Actions             │            │
│   └────────────────────────────────────────────────┘            │
│   AVIONICS DIAGNOSTIC SYSTEM            JAWS'99      13          │
└─────────────────────────────────────────────────────────────────┘
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Illustrative Avionics Diagram Page

A successful Diagnostics processing concludes with this page being drawn.

This shows an example Avionics Diagram Page display in which each of the display areas are populated with data describing the ADS session and bus and device health as determined by the ADS.
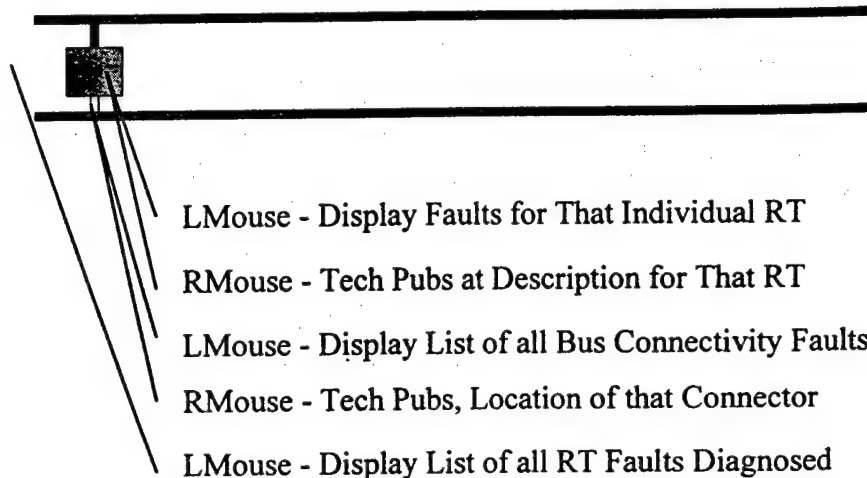
Colorable Graphics of Diagnostic's Avionics Diagram Page

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   14
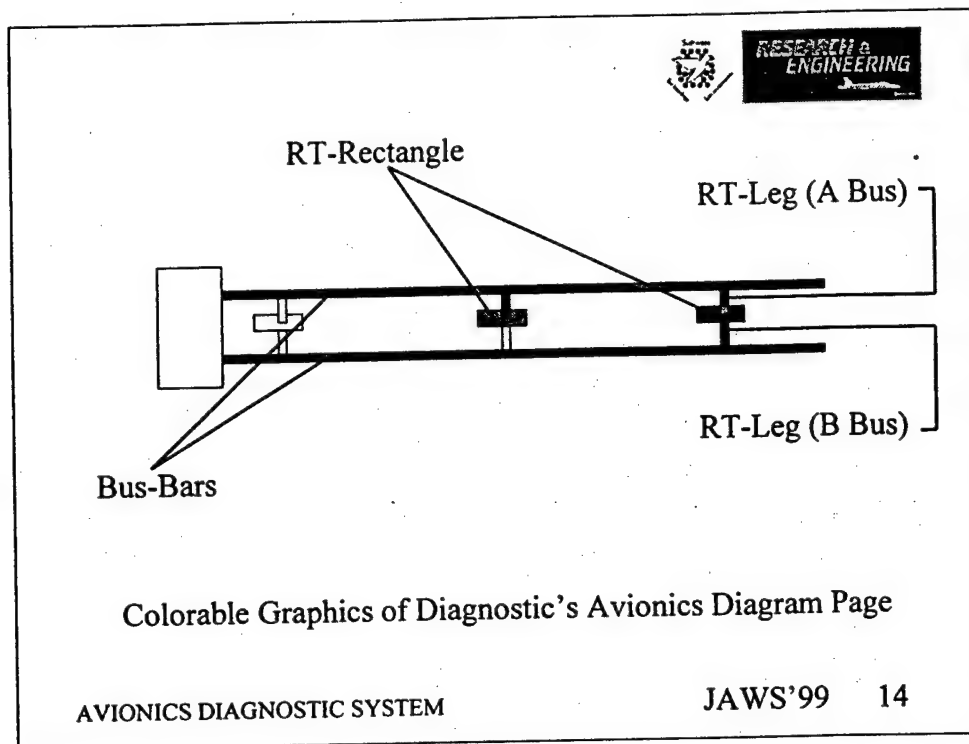
This shows which and how many graphical items may be colored using a color scheme that communciates diagnosed avionics state.

SESSION CTRL CMDS

COLLECTION_TIME = <sec>

OFFLINE = <list>

IGNORE = <list>

ASSERT = <list>

INITIAL_MSGNUM = <int>

TERMINAL_MSGNUM=<int>

DISASSEMBLE

BCC_MODE = < full | abbreviated >

AUTOCOLLECT = <boolean>

AUTODIAGNOSE = <boolean>

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   15

SESSION COMMANDS

LMouse - Display Faults for That Individual RT

RMouse - Tech Pubs at Description for That RT

LMouse - Display List of all Bus Connectivity Faults

RMouse - Tech Pubs, Location of that Connector

LMouse - Display List of all RT Faults Diagnosed

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   16

This shows how the mouse is used to obtain additional information about the item represented by the graphical display.

MENU COMMANDS

BIT SUMMARY PAGE

Aircraft Type: F14   DCF: D:\0201-F1.DAT Analyzed 11253 msgs
(in range 0..500000) (Normal Termination)

Description of Observed Bit and Status Messages

RTNAME (rtaddr)

TOTAL **PERIODIC** MSGS: <int>

PERIODICS INDICATING AVIONICS ERROR: <int>

PERIODIC MSGS NOT RESPONDED TO: <int>

TOTAL **MANUAL** MESSAGES: <int>

MANUAL MSGS INDICATING AVIONICS ERROR: <int>

MANUAL MSGS NOT RESPONDED TO: <int>

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   17

The BIT Summary Page results from clicking on the BIT Summary Menu Item. BIT Summary displays a count of the observed Periodic BIT and Manual BIT messages, for every RT. The summary shows two related items

(1) the number of these BIT results messages that have bits that indicate a problem exists within the RT,

(2) the number of times the Mission Computer requested a BIT status message but the RT failed to comply.

The1553 Summary Page results when the user clicks on the 1553 Summary Menu Item. It summarizes errors in 1553 communications within the portion of the data file analyzed as reported by the 1553 card/Collection Program.

Two types of 1553 communications errors are monitored

(1) Failure to respond to a request to produce message and

(2) Responses that have bits set in the 1553 Status Word.

Both types of problems are thresholded against a multiplier to determine if this level of error is acceptable or unacceptable.

CD-ROM   HARD DISK   RESEARCH & ENGINEERING

E: D: C:

BUS_COLL   ADS   LIBRARY

...   Type1 Type2 BIN   ...

PUBS

1553 BUS DATA FILE(S)

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   19
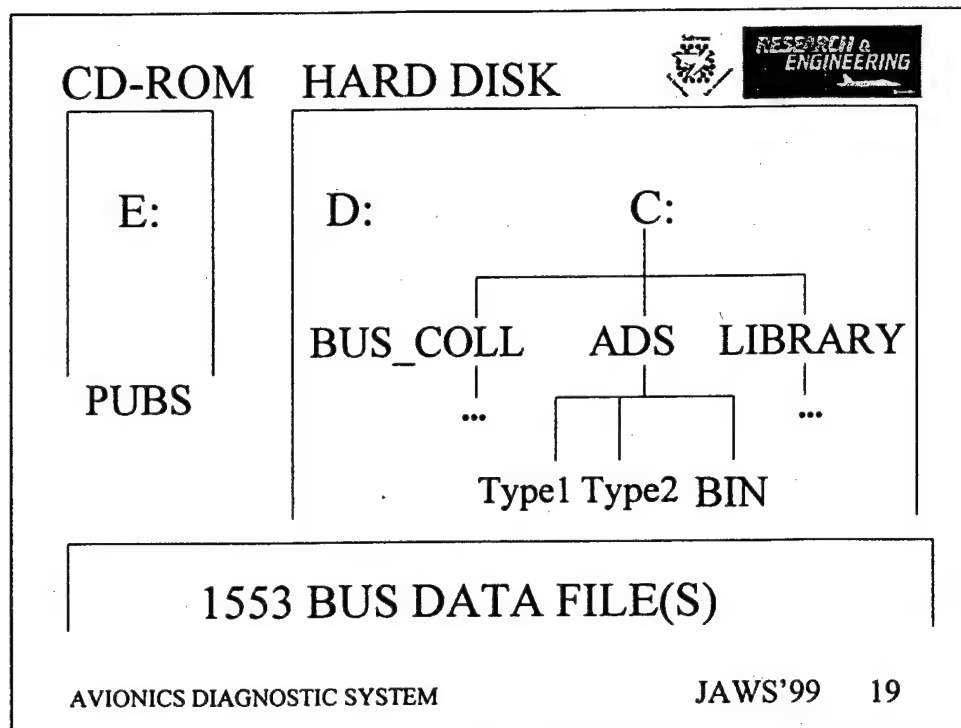
This viewgraph ends presentation of description of design details for the ADS.

It illustrates how the CD-ROM has given us the ability to easily store the electronified publications, and that the bus data collected may be stored either on the hard drive or on the CD-ROM.

It also shows some provision for extensibility, i.e the organization of the ADS systems files includes data for different types of aircraft.

RESEARCH & ENGINEERING

- WHEN ADS DISAGREES WITH OP PGM STATUS

- NEED TO ID MESSAGES USED TO DETERMINE
  PRIMARY BUS, SHOULD SECONDARY IDENT BE MADE

- SOME COLORATIONS NOT EASY TO DECIDE

- HOW TO COLOR BUS GRAPHICS

- SOME DEVICES ARE MANUAL BIT ONLY

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   20

The A/C's Operational Program has its own pages for reporting Avionics and Bus Health. The ADS did not try to duplicate the function and display of the Operational Program Health reportings. As a result these two diagnostic reports may not agree.

An algorithm was created to determine which bus each RT is using as its primary bus, the A-bus or the B-bus. The determination is based on monitoring of selected messsages the RT is known to have to send on a certain bus (primary or secondary). What if those messages are missing, must we designate more than one when coding the ADS ?

Meaning and Choice of RT Colorations. Some RT's have no messages. As a result their condition is unknown in the sense of condition derived from avionics health message analysis. If we color them Yellow for Unknown then the display is never fully Green. If we color them Green for OK we may create a false impression of knowledge about the device.

Coloration of Bus Graphics. A similar situation exists, some RT's may not use a particular bus.

Manual Bit. For these we cannot monitor health by Bit unless messages are on the bus. Our solution - (1) the Operators Manual describes this and how to interact with the OpPgm to cause the desired message to be emitted. In addition (2) the BIT Status reporting page reports data on observed Periodic BIT messages independently from Manual BIT messages.

- WHEN IS LEVEL UNACCEPTABLE LEVEL

    1553 ERRORS

    NUMBER OF PRIMARY BUS SWITCHES

    SOFT BIT ERRORS

- RECOMMENDED ACTIONS - FROM TECH PUBS

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   21

A Level is a percentage of observed messages within the range examined, when is a Level considered unacceptable ?

Is unacceptable considered **Fatal,** if so the device or bus should be colored Red ? This may imply the operator should be told to seek corrective action which may include swap out equipment.

Thresholded Items:

   1553 Errors - the Status Word bits in the 1553 return words.

   Number of Primary Bus Switches - ADS determines an RT's primary bus (certain messages are to be sent over primary bus). If this is changing then when has it changed too often.

   A BIT error is an RT error as reported in the RT's BIT message(s). If during analysis of a bus collection the RT sometimes reports the error and sometimes reports no-error then the ADS considers this to be a **Soft Bit error**. Besides the need to establish thresholds do such Soft-Bit thresholds vary per RT ?

The Tech Pubs are approved maintenance and diagnostic procedures. Should the Recommended Actions displayed to the user only come from these pubs, or can the ADS offer other non-ADS avionics related advice ?

SUMMARY

WHAT THE ADS DOES NOT DO /
WHAT IT COULD DO

EXTENSIBILITY TO OTHER A/C (EASE OF)

LESSONS LEARNED

CONCLUSIONS

AVIONICS DIAGNOSTIC SYSTEM   JAWS'99   22

This shows the topics that will be discussed in summarizing this description of
the ADS.

The first sections describes some **other types of diagnostic capabilities** the
ADS could perform.

The next section presents an overview of what designing and coding the ADS
taught us or suggests about easily hosting it to **other types of A/C**.

Lessons Learned provides generalizations about the new types of knowledge
obtained during the ADS work.

Conclusions bulletizes the utility of the tool we created.

The following are other and additional diagnostics and improvements that could extend the ADS's utility.

Certain messages are to be emitted or received at defined intervals, does the observed data bear this out ?

When displaying an electronified publication highlight those areas of text related to why the pub is being displayed. For example an RT is diagnosed showing a specific fault so in the displayed pub highlight the text related to that RT's (Location in the A/C, Size, Shape and Markings, etc).

The IAMS devices are hard-wired discretes and as such do not report status using1553 messages. However messages between Mission Computers report IAMS statuses, to keep the backup mission computer up to date. So the ADS could use these messages to report the status of the IAMS devices.

The Bus Connectivity output (which reports a possible open-circuited bus connector) identifies the one connector which if opened would cause the observed missing messages. However other combinations of open circuits and dead and offline RT devices could result in identifying a connector which is not really open. The output could enumerate all such equivalences.

To mirror the A/C's OpPgm's Health Displays the ADS needs to see *enough* messages (see an equiv sample as the OpPgm saw). And/or intercept OpPgm messages causing OpPgm Health display so these could be displayed to the ADS user.

Provide a database for each A/C, historically show freq of 1553 errors, primary bus switches, RT errors, etc so as to trend an a/c and the devices in the a/c.

RESEARCH &
ENGINEERING

BUS MESSAGE BIT MONITORING ABOUT GENERIC

ONE HAS TO DECIDE WHICH MESSAGES HAVE RT
HEALTH, AND OF THOSE WHICH BITS

HAVE TO PICK THOSE MESSAGES USED TO
DETERMINE WHICH IS THE PRIMARY BUS

BUS LAYOUT / RT POPULATIONS DIFFER PER A/C
- DEVELOP GRAPHICAL DISPLAYS PER A/C

BUS CONNECTIVITY ALGO PROBABLY GENERIC

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Extensibility refers to modifying this program so that it can be used on other aircraft, aircraft not used in the initial design, development and testing. This viewgraph summarizes some things to consider when trying to realize extensibility.

Code for BIT Message Monitoring. *same code* used repeatedly for each different RT (its inputs specify for an RT the number of BIT messages and for each identify the messages and the intramessage words and bits that are of interest (are monitored as communicating RT Health)).

Open Circuited Bus Connectors. Represent the RT configuration as a tree then code as a data structure. This method seems and is believed to be generic but it has not tested on other a/c layouts.

DATA COLLECTION PROGRAM MARRIED TO
A 1553 CARD

MODIFICATION OF DATA COLLECTION PGM EASY
FOR US - WE HAD ITS SOURCE AND EXPERTS

PERSONNEL CONCURRENTLY DEVELOPING THE
VIEWER PROGRAM ACCOMMODATED US

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Data Collection and 1553 Card. The data collection program also formats
data it collected before it deposits it to the binary collection file that is an input
to the ADS.

ViewerProgram. Viewer developers electronified our documents for us,
first. Also they were able to transparently make the small modifications
necessary so their program could be used within our ADS design as we hoped.
For other A/C need to determine transitions, where in the electronified
document the Program is to open its display to, and input these into Viewer.
The Viewer was (probably) not hosted to read such from external files so it
would need rebuilding for each such other A/C.

Leveraging. But we were in right place at right time on two counts (1) experts available and (2) concurrent developments. Our approach was not to excise or to add functionality to the Data Collection Program, but to include the whole program as an executable invocable from the ADS session. With only a small amount of mod we were able to make its data collection services available for direct use by the ADS program and in addition we could optionally provide to the ADS user the entire Data Collection Program if they want it. The same for Viewer. Regarding Viewer we realized several goals, albeit not as fully as we first wanted, just by having the Tech Pubs on-line with an ability to open the Viewer to a specified page within them. This ability provided text showing the user the Location in A/C, with the Device Characteristics and Markings, and with the Test and Maint Procs). Perhaps being in the right place at the right time it was not as much luck as successful **planning** by management.

Our first Windows Applications (circa Visual C++ 1.2 - 1.5). A lot of learning in transitioning to this other paradigm. Even today after experience and training grey areas continue. Also, these methods are not static, they are changing (type of applications creatable).

Since the **files that should be most ideally CM'ed** were not known we CM'ed about all, to be assured we could restart the Visual C Development Studio and still find our Resource and Menu definitions along with the expected ID linkages among the classes.

Visualization and Computer Graphics creates outputs that are easily understood. However consensus is still necessary for a common understanding because of meaning of colors (yellow can denote *OK*).

CONCLUSIONS

ELECTRONIFICATION OF TEST AND MAINT PROCS

- MADE A LOT OF APPROVED DATA ALWAYS AVAILABLE
- FACILITATES ADHERENCE TO PROTOCOL

THE ADS PROVIDES **FASTER ASSESSMENT** OF BUS AND AVIONICS

NEW TECHNOLOGY MADE THIS ADS POSSIBLE

- MEMORY, CHEAP CD-ROMS, METHODS FOR DOCUMENT ELECTRONIFICATION, ABILITY TO CREATE WINDOWS APPLICATIONS

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